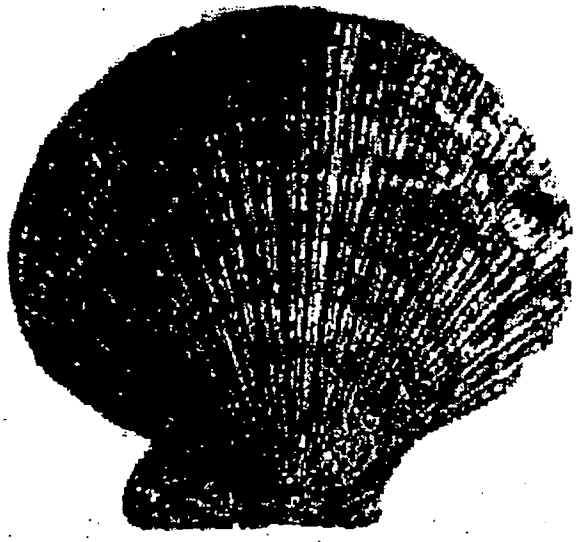

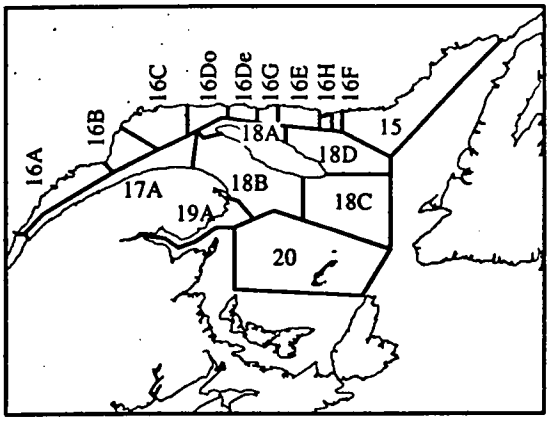

Scallops of the Inshore Waters of Québec

Background

There are two species of scallop in the Gulf of St. Lawrence, the sea scallop and the Iceland scallop. They reach commercial size at age 5 in the case of the sea scallop and age 8 in the case of the Iceland scallop. The sexes are separate and fertilization takes place externally. The spawning season is short and does not occur at the same time throughout the Gulf. Larval development takes nearly five weeks. Scallops are sedentary and live in aggregations known as "beds".

In Québec, commercial harvesting began in the mid 1960s. It is an inshore fishery, taking both species without distinction. Catches are landed mostly as muscle, or meat. The Laurentian Region is divided into 17 areas and has 82 fishing licences. All areas are managed by controlling fishing effort, but the Middle North Shore and Anticosti Island are also governed by individual quotas. Since 1980, the North Shore has been the most productive region in Québec.

Summary

Îles-de-la-Madeleine

- The harvestable biomass is at its lowest level since 1984 on the traditional fishing grounds.
- Only one cohort of prerecruits (that of 1995) was found in the 1997 population. However, it will not be recruited for fishing until the year 2000 or 2001.
- Harvesting rates are about 85 % on some fishing grounds.
- There are serious concerns for the conservation of the Îles-de-la-Madeleine stock. We therefore recommend that no scallop fishing be allowed on the Sud-Ouest, Étang-du-Nord, Chaîne-de-la-Passe and Dix-Milles fishing grounds until the reproductive biomass has rebuilt.

Gaspé

- The increased fishing effort of recent years risks damaging the scallop population of area 19A. We therefore recommend reducing landings to the levels recorded between 1990 and 1994.
- The situation in areas 18B and 17A is not serious for the time being, given the low fishing effort.

North Shore

- Areas 16A and 16B have been underfished in recent years. However, there has been a significant increase in fishing effort in area 16C. Here, it would be useful to set harvesting limits without delay to prevent local overfishing.
- The situation in areas 16 Do, 16De, 16G and 18A was relatively stable in 1997, notwithstanding a slight drop in abundance indices. We feel that fishing effort can be safely maintained in these areas in 1998, though we shall need to be very alert.
- For the time being, no increase in fishing effort is recommended in area 15 on the Lower North Shore.

Biological context

There are two indigenous species in Eastern Canada, the sea scallop (*Placopecten magellanicus*) and the Iceland scallop (*Chlamys islandica*). In the Gulf of St. Lawrence, these two species are found mainly on gravel, shell or rocky bottoms, at depths of 20 to 60 metres. Geographic distribution is different for the two species. In the Gulf of St. Lawrence, the Iceland scallop occurs on the North Shore, around Anticosti Island and on the north shore of the Gaspé, but is virtually absent in the southern Gulf. By contrast, the sea scallop is found primarily in the southern Gulf, including the Îles-de-la-Madeleine and Chaleur Bay, and occasionally appears on the Lower North Shore.

The sea scallop grows at a faster rate than the Iceland scallop. Growth varies from one region to another, and is chiefly influenced by habitat quality and environmental conditions. In the Gulf of St. Lawrence, commercial size is reached at about age 5 for the sea scallop and age 8 for the Iceland scallop.

In scallops, the sexes are separate and eggs are fertilized externally in the water. The spawning period is short and does not occur at the same time Gulf-wide. In the sector extending from Havre St Pierre to Johan-Beetz Bay, Iceland scallop spawn in July, whereas in the rest of the Middle and Lower North Shore and off Anticosti Island, spawning occurs between mid-July and late August, depending on the sector. Sea scallops spawn in August in Chaleur Bay and in late August in the Îles-de-la-Madeleine region.

Larval development takes about 5 weeks, from fertilization until settlement on the bottom. The larvae seek to attach themselves to the seabed, in fairly close proximity to adult scallops. Certain conditions, such as the presence of filamentous organisms, are required for successful settlement. Dredging during the month preceeding the fixation spat on the bottom, as well as during the few months that follow can adversely affect the success of the spat's fixation on the bottom. The interruption of fishing during this period would reduce the deleterious impacts of the gear on the bottom.

Scallops are sedentary and live in aggregations called "beds". This fact is important to consider when developing conservation strategies and harvesting approaches. Since resource conservation measures are designed to ensure the sustainability of each bed, they must afford protection that allows the scallop population at each site to renew itself.

It is therefore reasonable to expect that an approach aimed at augmenting reproductive potential by leaving more adults on the bottom or by creating shelter areas would have a positive impact on resource conservation. Since female scallops produce eggs in proportion to their size, there would be a net gain in productivity by allowing individuals to grow and the population to age. This approach would offer the added benefit of in-

creasing yield per recruit and hence commercial profitability.

Mass mortality are a phenomenon that has been known to occur several times in the Gulf of St. Lawrence. This is a variable that can have a serious impact on harvesting, especially in beds close to the limits of the species' range.

The fishery

Commercial harvesting in Québec targets Iceland scallops and sea scallops indiscriminately. Catches are generally landed as muscle (meat) and occasionally as meat and roe (muscle and gonad) or in the shell (whole). It is not possible to distinguish the adductor muscle of the two species visually; the whole animal is needed to make this identification. However, the two species are not uniformly distributed in the Gulf of St. Lawrence, and catches in any one sector usually consist of just one species.

In 1997, the Québec Region comprised 17 fishing areas divided among three sectors, namely the Îles-de-la-Madeleine (Area 20), the Gaspé (Areas 19A, 18B and 17A) and the North Shore (Areas 16A, 16B, 16C, 16De, 16Do, 16E, 16F, 16G, 16H, 15, 18A, 18C and 18D) (Figure 1). Areas 18C and 18D, however, have not yet been harvested. Last year a total of 82 regular licences were issued. Management plans varied depending on the area, based on the following factors: vessel length, drag size, fishing season and hours, and individual quota.

In the Gulf of St. Lawrence, the scallop fishery is essentially an inshore fishery. The Digby-type drag has been used since harvesting began in Québec. Over the years, there has been a significant increase in fishing effort, primarily as a result of the fleet's increased fishing capacity and effectiveness.

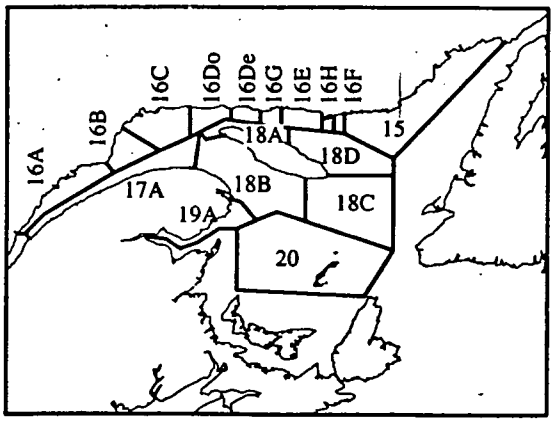

Figure 1. Québec scallop management units.

Landings in the Îles-de-la-Madeleine have fluctuated widely since the beginning of the commercial fishery (Figure 2). The scallop stocks in this region collapsed in 1971. Landings on the North Shore rose rapidly from 1984 to 1990. There has been a levelling off of catches since 1991 owing to the introduction of individual quotas on the Middle North Shore.

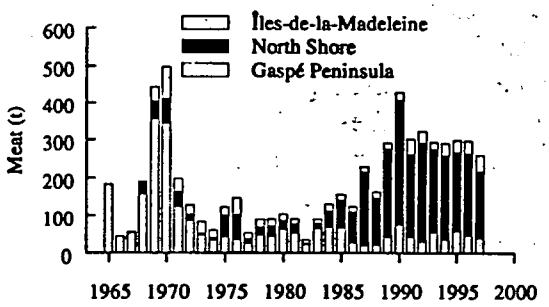

Figure 2. Scallop landings in Québec.

Landings in 1997, which totalled some 260 t of meat, came from the North Shore (69 %), Gaspé (16 %) and the Îles-de-la-Madeleine (15 %).

Assessment of the status of the scallop populations of the Gaspé and the North Shore, except for area 16De, is essentially based on commercial indices. The Îles-de-la-Madeleine population, and area 16De, are

evaluated on the basis of both commercial and research survey indices.

In a case where no research index is available, the population status assessment is wholly dependent on the quality of the data furnished by the fishing industry. According to well-informed sources, unreported catches have been so large over the past few years that the reliability of analyses based on fishing statistics can be called into question.

Information specific to scallops in the Îles-de-la-Madeleine, Gaspé and North Shore regions is presented in the following sections. Since it is not yet possible to provide advice for each of the small beds scattered along the Québec coast, this review is organized according to management units. A group of scientists examined the data during the regional review of invertebrate stock status in the Laurentian Region.

Îles-de-la-Madeleine (Area 20)

The Îles-de-la-Madeleine sector comprises several principal scallop concentrations, namely the fishing grounds of Étang-du-Nord, Dix-Milles, Chaîne-de-la-Passe, Sud-Ouest, Île Brion and Banc de l'Est (Figure 3). In 1997, 23 licences were active. These beds were open to the fishery from April 15 to September 30, except for the eastern part of Chaîne-de-la-Passe, which opened only on July 15, while the western part remained closed year-round. The fourth bed, the Sud-Ouest, has been closed to harvesting since 1990. In 1997, the Banc de l'Est was fished for the first time in several years.

Over 95 % of the Îles-de-la-Madeleine catches generally consist of sea scallops, with Iceland scallops making up the remainder. Since 1990, landings have ranged from 29.9 t to 73.9 t (Table 1). From 1995 to 1996 and 1997, muscle landings dropped,

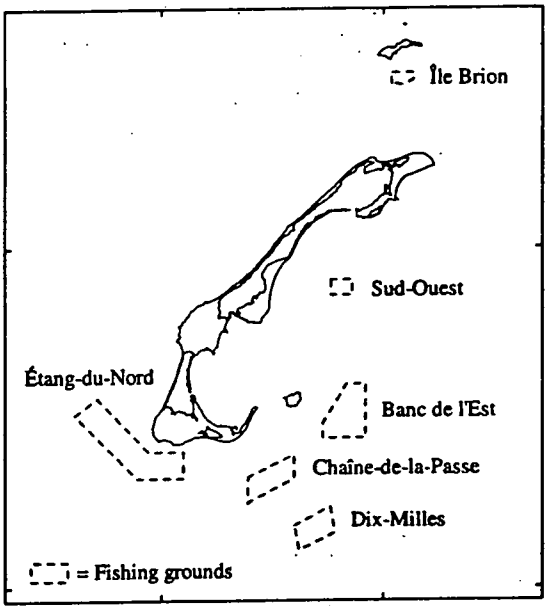

Figure 3. Principal scallop fishing grounds of îles-de-la-Madeleine.

Table 1. Scallop landings (t of meat) and catch per unit effort (kg of meat per fishing hour and metre of drag) in the Îles-de-la-Madeleine.

	1991	1992	1993	1994	1995	1996	1997[1]
Catch	42.2	29.9	55.6	36.7	58.9	47.0	38.9
CPUE	1.07	0.91	1.21	0.80	1.27	0.85	0.87

[1] preliminary value

from 58.9 t to 47.0 t and then 38.9 t respectively.

The increase in catches per unit effort (CPUE) in 1993 was due to recruitment of the 1988 cohort, which was relatively abundant. This cohort was harvested intensively and exhausted within a few weeks. In 1994, catches per unit effort fell to an all-time low for the past ten years. However, the Chaîne-de-la-Passe bed, which contained the highest scallop densities, was closed to the fishery. Higher catches per unit effort and landings in 1995 were attributable to harvesting of the 1989 cohort in the western part of the Chaîne-de-la-Passe area. In 1996, Chaîne-

de-la-Passe was closed, and catches per unit effort slumped. In 1997, even though the eastern part of Chaîne-de-la-Passe (where the remainder of the 1989 cohort was caught) and an old fishery grown (Banc de l'Est) were harvested, catches per unit effort remained unchanged from 1996, ie 0.87 kg per hm.

The research indices provide a clear picture of the fluctuations in prerecruitment, that is, scallops smaller than 70 mm, and in recruitment (scallops greater than 70 mm) (Figures 4 and 5). Prerecruits peaked in 1992, then gradually declined until 1996. In 1997, the prerecruitment index grew thanks to the 1995 cohort. However, this cohort is much smaller than those of 1984, 1988 and 1989. The abundance index for recruits followed a similar trend, but with a two-year lag, corresponding to the time needed for prerecruits to reach recruitment size.

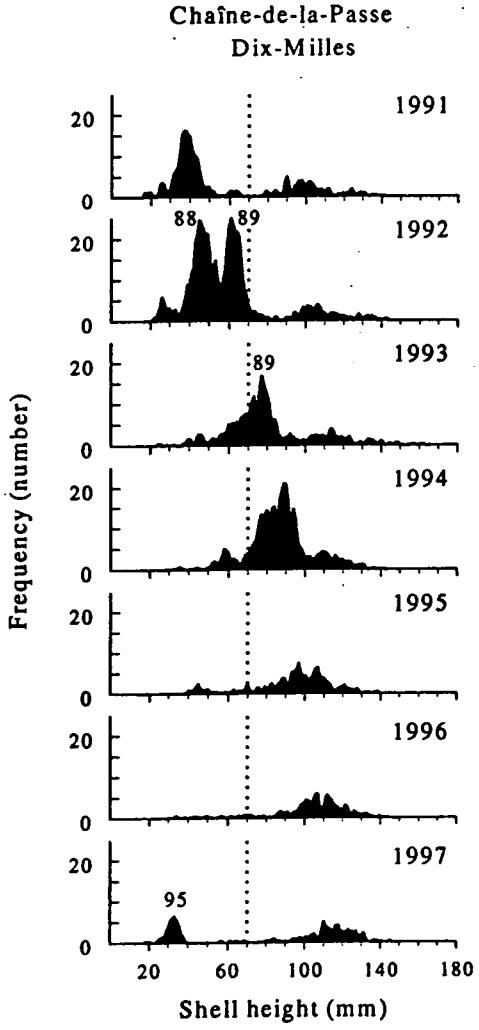

Figure 4. Size structure of îles-de-la-Madeleine sea scallops sampled during research surveys.

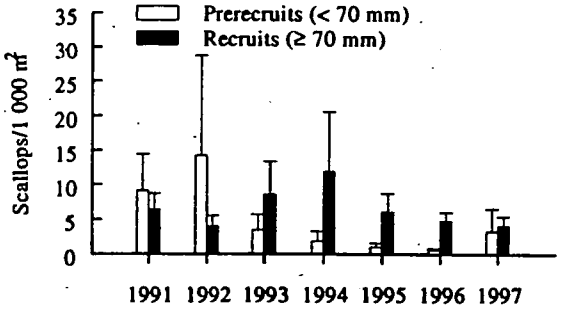

Figure 5. Density (± 2 standard errors) of sea scallops sampled in the îles-de-la-Madeleine during research surveys.

Scallop mortality in the Îles-de-la-Madeleine can be estimated by monitoring cohort survival from year to year in research surveys. In general, overall mortality is relatively low. However, local mortality on actively harvested beds can prove to be extremely high, corresponding to a harvesting rate of about 85 %.

Research survey data can be used to derive an abundance index of 2-year-old prerecruits, which can in be used to predict the abundance of recruits that will be available to the fishery in 3 years, at age 5. This index, which has proved reliable hitherto, suggests low recruitment for 1998 and 1999, but

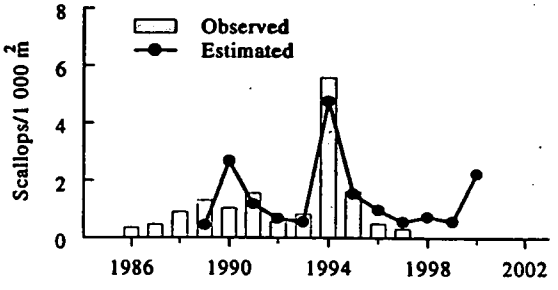

Figure 6. Density of 5-year-old recruits, values from current research surveys and values projected from numbers of 2-year-old prerecruits observed in research surveys 3 years earlier.

slightly higher levels for the year 2000 (Figure 6).

Prospects

Scallop abundance on the traditional Îles-de-la-Madeleine fishing grounds was very low in 1997. Our research surveys showed that the harvestable biomass was at its lowest since 1984, and it is estimated to be only one-tenth of what it was in the late 1960s. Recruitment was very low. The last large age classes to be recruited were those of 1988 and 1989. Since then, there has been no significant recruitment. Only one prerecruit cohort (that of 1995) is present in the population, but it is much less abundant than those of 1988 and 1989. This cohort will be recruited for fishing in the year 2000 or in 2001.

In 1997, all traditional fishing grounds were harvested, including the last of those closed in 1993, and were completely cleared of scallops, with harvesting rates reaching 85 % locally. The fleet's fishing effort is much too great for the productivity of the Îles-de-la-Madeleine scallop beds. In line with the management philosophy adopted on the Middle North Shore, fishing effort needs to be reduced to about one-fifth of what it is. Regardless of the many recommendations made to this effect, fishing effort has never been cut back.

There is serious concern for the conservation of the stock. The biomass is at record low levels, and without recruitment breeding stocks will not rebuild any time soon. Any commercial fishing will entail further declines in the reproductive biomass to levels never yet seen. We therefore recommend that no further scallop fishing be allowed on the Sud-Ouest, Chaîne-de-la-Passe, Dix-Milles and Étang-du-Nord grounds until the reproductive biomass has recovered. The season should also close in mid August to protect spat as it settles.

Gaspé (Areas 19A, 18B and 17A)

The Gaspé comprises three harvesting units, areas 19A, 18B and 17A. In 1997, area 19A had six regular fishing licences. Fishing was permitted there from 5 am to 7 pm, Monday to Saturday, from April 1 to September 15. In area 18B, there were two licences with individual quotas. In area 17A, only one licence was issued. There is no fishing season or schedule in the latter two areas.

Gaspé landings come mainly from Chaleur Bay (Area 19A) and Anticosti Island (Area 18B) (Figure 7). The targeted species in Chaleur Bay is mainly the sea scallop, while off Anticosti Island and the north shore of the Gaspé the Iceland scallop is harvested.

In area 19A, landings have been relatively stable since 1991 (Figure 7). Occasional newcomers to the fishery (licence transfers) account for fluctuations in effort. In 1997, landings reached their highest level since 1987, namely 21.4 t of meat.

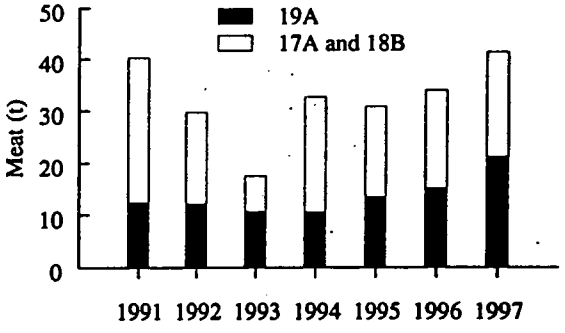

Figure 7. Scallop landings.

Catches per unit effort show the same lack of variation over the same period (Table 2). From 1994 to 1996, catches per unit effort were low but relatively stable. In 1997, they returned to 1992 and 1993 levels.

Table 2. Catches per unit effort (kg of meat per fishing hour and metre of drag).

	17A	18B	19A
1991	1.07		0.88
1992	1.67	0.92	0.93
1993	1.51		0.96
1994	2.06	2.71	0.74
1995	1.57	0.98	0.73
1996	1.27	1.19	0.71
1997	0.99	1.32	0.94

Size structure in commercial samples from area 19A indicates that the average size of scallops available for fishing was distinctly smaller in 1996 and 1997 (Figure 8). This trend is due to the greater fishing effort in Chaleur Bay, resulting in more intensive harvesting of large specimens and redirection of fishing effort toward younger cohorts.

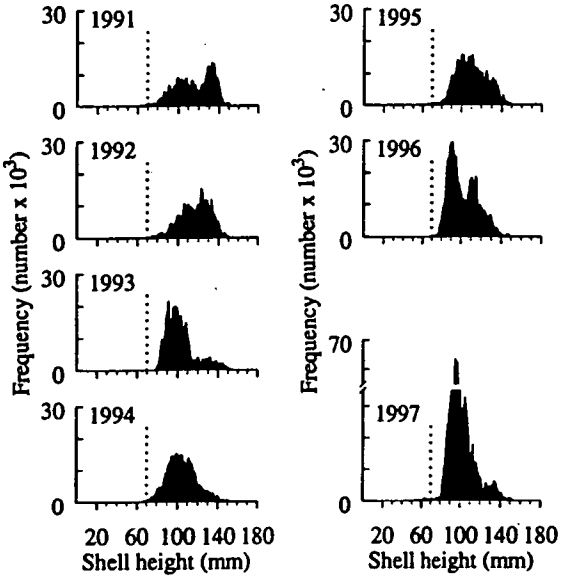

Figure 8. Size structure of sea scallops in area 19A according to commercial sampling.

The impact of this heightened effort will probably be felt soon, since there has been no sign of substantial recruitment for ten years. Catches per unit effort may thus drop.

On the north shore of the Gaspé Peninsula (Area 17A), landings are low, and CPUE have declined since 1994 (Figure 7; Table 2). For several years, the input from the western end of Anticosti Island (Area 18B) has been variable. Harvesting has a short history here, and the fishery is still evolving. In both areas, the mortality (% of clappers) and prerecruitment indices are stable, though catch size has declined since 1996 in 17A and since 1994 in 18B.

Prospects

Recent fluctuations in Gaspé scallop landings are due to irregular harvesting of Iceland scallops southwest of Anticosti Island. Chaleur Bay landings are relatively constant, such variation as there is being attributable to changes in fishing patterns and fluctuations in recruitment abundance.

The poor recruitment of the past ten years means that scallop abundance in Chaleur Bay cannot be expected to improve for some years. The increased fishing effort seen in the last few years may have adverse consequences for the scallop population in area 19A. We therefore recommend reducing landings to the levels posted in 1990 and 1994. The season should also be closed at the beginning of August to protect spat as it settles.

There is less cause for concern in areas 18B and 17A for the time being, given the low fishing pressure on this resource.

North Shore

The North Shore is divided into 11 separate fishing areas between the mouth of the Saguenay and Blanc Sablon. North Shore landings were some 180 t of meat in 1997. The largest share of this came from the Middle North Shore, somewhat less from the Lower North Shore and less still from the Upper North Shore.

Areas 16A, 16B and 16C

Landings in these areas, which are broadly coterminous with the Upper North Shore, consist of Iceland scallops. There are five boats operating in this fishery, and fishing effort is low. These areas are managed by restricting the number of licences. Fluctuations in catches per unit effort and landings reflect the fishing pattern in areas 16A, 16B and 16C (Figure 9; Table 3). There have been few, if any official landings in areas 16A and 16B since 1995.

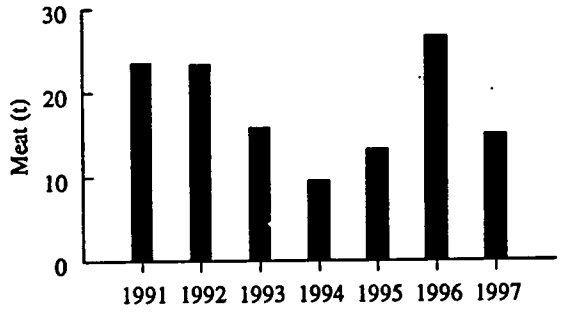

Figure 9. Scallop landings in areas 16A, 16B and 16C.

Discovery of a new bed in area 16C accounts for the rise in landings and catches per unit effort since 1995. Sales of unshucked (live) scallops partly explain higher yields, as no shelling need be done aboard ship.

Table 3. Catches per unit effort (kg of meat per fishing hour and metre of drag).

	16A	16B	16C
1991		4.16	2.78
1992	0.80	2.25	4.34
1993	0.76	1.82	2.94
1994	1.23	2.80	1.89
1995		1.38	7.60
1996		1.00	7.86
1997			5.71

Size structure of commercial samples is characterized by specimens with a shell height of about 80 mm.

Prospects

Exploratory work and current catches suggest that the potential of areas 16A, 16B and 16C is limited. Little fishing has been done in areas 16A and 16B for some years. However, there has been a steep increase in fishing effort in 16C. Here, it would be sensible to set harvesting limits promptly to avoid local overfishing.

Areas 16Do, 16De, 16G, 16E and 18A

Seven fishermen have access to areas 16De et 16Do, nine to 16G and 18A, and four to 16E. Each of these areas, which together broadly make up the Middle North Shore, are subject to quotas, and fishing is further regulated by daily and seasonal scheduling. This is the most productive region in Québec, and Iceland scallop landings have risen sharply since the early 1980s.

There has been a marked decline in effort since 1990. This is linked to the imposition of individual quotas in 1991, shortened fishing seasons in all areas and lower quotas in 16D in 1993. Subdivision of area 16D into 16Do and 16De, lower quotas in 16De and 16G and higher quotas in 18A also influenced fishing effort. Changes were insignificant in 1997, though, as quotas in 16De were only slightly lower.

Landed volume reached an all-time high of nearly 300 t of meat in 1990 (Figure 10). In 1991 landings dropped substantially, especially in area 16De. From 1993 through 1995, landings in areas 16De, 16G and 16E were relatively stable. In 1997, landings in these areas amounted to some 143 t of meat, the largest landings being in 16De and 18A.

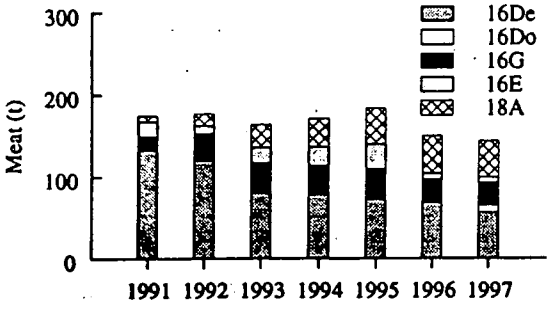

Figure 10. Scallop landings.

Since 1994, there has been a steady fall in catches per unit effort in 16De and 16E. In 1997, catches per unit effort grew in areas 16G (13 %) and 16Do (45 %), but fell in 18A (28 %). Except for area 16Do, where exploration is just starting, catches per unit effort declined from west (16De) to east (16E) because of local productivity variations (Table 4).

Table 4. Catches per unit effort (kg of meat per fishing hour and metre of drag).

	16Do	16De	16G	16E	18A
1991		6.51	5.16	3.45	7.00
1992		7.15	6.31	4.16	5.35
1993		6.83	5.76	3.16	4.90
1994		7.84	5.31	3.01	4.74
1995		6.87	4.31	2.63	5.49
1996	1.46	6.26	4.25	1.92	5.94
1997	2.66	5.63	4.90	1.89	4.31

The mortality rate (% of clappers), based on commercial sampling, almost doubled from 1995 to 1996 in 16D and 16G (Figure 11). Natural mortality rose from 20 % to nearly 40 % in these two areas over this period. Mortality was below 24 % in 1997, falling in almost all areas. Preliminary results of current work suggest that the index used may overestimate mortality.

In 1997, the size of scallops in commercial samples from areas 16G and 18A was a little smaller. In other areas, the size of scallops taken was stable. However, there is a distinct variation among areas, with a decline in average size from west (16De) to east (16E) and from north (16De) to south (18A).

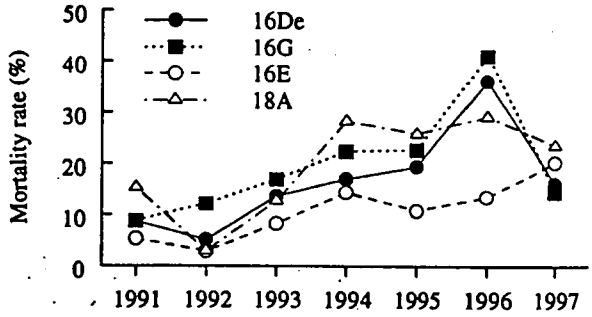

Figure 11. Natural mortality rate of Iceland scallops according to commercial sampling.

Prospects

At present, it is impossible to gauge the situation in each management area with any precision, especially as areas 16Do and 16E are still largely unexplored. Reduced fishing effort since individual quotas were introduced in 1991, together with the multiplication of areas, has spread harvesting over a larger territory.

Though the Middle North Shore scallop beds appear to be very productive, they are sensitive to intensive fishing. Low catch rates in 1997 relative to historical data from areas 16De, 16G and 18A enjoin strict vigilance.

Areas 16H, 16F and 15

There are 34 active licences east of Natashquan, all of them granting access to areas 15 and 16F. One fisherman in area 15 and two in area 16E also have access to area 16H. Historically, landings in this region consisted mainly of sea scallops, but since 1992 catches of Iceland scallops from the western

end of area 15 and areas 16F and 16H have accounted for a larger share.

Landings grew from 1990 to 1992 and remained relatively high in 1993 and 1994 thanks to catches of Iceland scallops from areas 16F and 16H. The drop in catches in area 16F from 1994 to 1995 is associated with reduced catches per unit effort (Figure 12; Table 5). In 1997, landings rose in areas 16H and 15 from 1996 figures. Catches per unit effort also grew in 1997. There has been no commercial fishing in 16F since 1996.

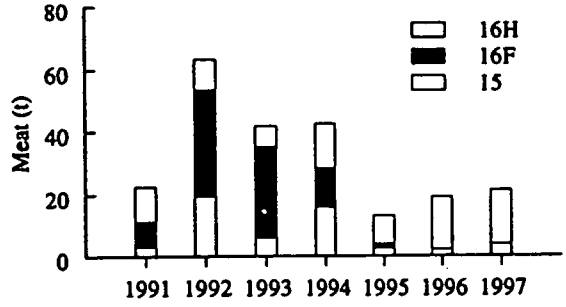

Figure 12. Scallop landings.

Table 5. Catches per unit effort (kg of meat per fishing hour and metre of drag).

	16H	16F	15
1991	5.64	4.51	0.67
1992	4.15	2.91	1.00
1993	2.58	2.75	1.14
1994	3.27	2.20	1.49
1995	2.15	1.40	1.12
1996	2.27		1.09
1997	2.75		1.45

Prospects

We know too little about the scallops of the Lower North Shore to be able to pronounce on the state of the resource. The scallop's biological characteristics and contiguous distribution, likewise the mass mortality reported from some fishing grounds, make the creature highly vulnerable to overfishing. For the time being, it would not be advisable to increase the fishing effort on sea scallops in area 15 in view of the mortality problems encountered on the Lower North Shore.

For more information:

Giguère, M. and S. Brulotte. 1997. État des stocks de pétoncle des eaux côtières du Québec Secrétariat canadien pour l'évaluation des stocks. Document de recherche 97/80.

Prepared by:

Michel Giguère
Tel. (418)775-0622
Fax. (418)775-0740
Email: giguerem@dfo-mpo.gc.ca

Published by

Regional Stock Assessment Office,
Department of Fisheries and Oceans,
Maurice-Lamontagne Institute,
P.O. Box. 1000, Mont-Joli,
Québec, Canada
G5H 3Z4

Email: Stocksrl@dfo-mpo.gc.ca

ISSN 1480-4913

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